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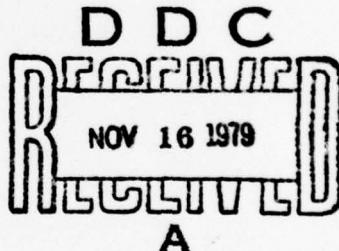
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## HUMAN FACTORS AND TRAINING IMPLICATIONS OF ADVANCED-CONCEPT CARGO VEHICLES

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U. S. Army

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Army Project Number  
16 2Q763743A775

Human Performance  
in Field Assessment

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6 HUMAN FACTORS AND TRAINING IMPLICATIONS  
OF ADVANCED-CONCEPT CARGO VEHICLES

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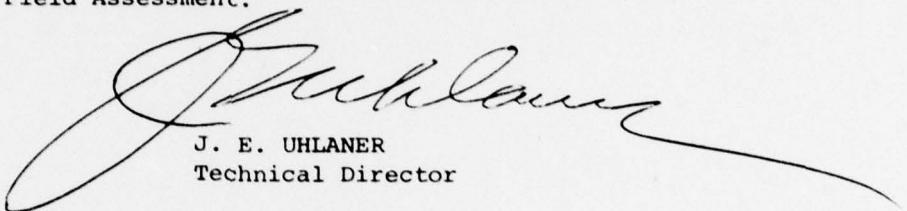
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FOREWORD

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By assessing the human performance aspects of man/weapons systems in field situations, the Fort Hood Field Unit of the Army Research Institute for the Behavioral and Social Sciences (ARI) provides evaluation support to Headquarters, TRADOC Combined Arms Test Activity (TCATA), formerly Modern Army Selected Systems Test Evaluation and Review (MASSTER).

This ARI report describes research to support MASSTER Test FM 265A (concerned with the impact of introducing high mobility vehicles into the Army inventory) by assessing the human factors aspects and driver training implications associated with several vehicles: M813, M520, M656, and Lockheed Twister Dragon Wagon. The data provided input to mobility programs and were responsive to the objectives of Army Project 2Q763743A775, "Human Performance in Field Assessment."

  
J. E. UHLANER  
Technical Director

HUMAN FACTORS AND TRAINING IMPLICATIONS OF ADVANCED-CONCEPT CARGO VEHICLES

BRIEF

Requirement:

To observe and report human factors and driver training implications associated with the use of specific high mobility vehicles.

Procedure:

ARI obtained human factors data (with the exception of noise-level data) and training implications data by administering two questionnaires to drivers of three types of vehicles: the Lockheed Twister Dragon Wagon (DW), the M813 5-ton truck, and the M520 GOER truck. (Noise-level data for these trucks and for the M656 cargo truck were obtained by the Field Instrumentation Division of the MASSTER Engineering and Instrumentation Directorate.)

Principle Findings: were:

- The Dragon Wagon was ranked significantly superior to the 5-ton and GOER on 16 of 26 human factors items;
- The Dragon Wagon was markedly superior to the 5-ton, GOER, and M656 on noise-level tests;
- Driver training provided on the Dragon Wagon was judged sufficient in 9 out of 14 areas by four or more of six drivers especially trained on that vehicle. In 5 areas three or more of the drivers felt that additional training would be useful, and
- The Dragon Wagon, GOER, and 5-ton each have selected characteristics that require special training.

Utilization of Findings:

The findings in this ARI report support MASSTER Test FM 265A ("Advanced Concept Vehicle--Cargo [ACV-C] ") and provide input to ongoing Army mobility programs and studies. An earlier version of this report has been incorporated into the MASSTER Test Report.

HUMAN FACTORS AND TRAINING IMPLICATIONS OF ADVANCED-CONCEPT CARGO VEHICLES

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## HUMAN FACTORS AND TRAINING IMPLICATIONS OF ADVANCED-CONCEPT CARGO VEHICLES

### INTRODUCTION

This ARI report supports MASSTER Test FM 265A ("Advanced Concept Vehicle--Cargo" [ACV-C]) conducted at Fort Hood, Texas during 7 March to 12 September 1974. The specific purpose of FM 265A was "to investigate the impact of using 5- to 15-ton payload cargo vehicles with advanced state-of-the-art mobility and ride characteristics in divisional type units" and to "provide input to mobility programs and studies" (Berry, 1975, p. 1). In general, FM 265A constituted part of an overall MASSTER program to evaluate high mobility concepts and the introduction of such vehicles into the Army inventory.

### PURPOSE AND OBJECTIVES

The purpose of this ARI study was to support Test FM 265A in two specific areas: (a) human factors, and (b) training implications. Thus, the ARI objective was to observe, analyze, and report human factors aspects of the test vehicles and to detail associated implications for driver training.

### PROCEDURES

#### HUMAN FACTORS

ARI obtained most of the human factors data by means of a questionnaire administered to drivers of the vehicles. The ARI Fort Hood Field Unit prepared and administered the questionnaire. Noise-level data, however, were collected with instrumentation operated by the Field Instrumentation Division of the MASSTER Engineering and Instrumentation Directorate. Although noise level is only one of several human factors considered in this test, it is discussed separately because of the different measurement approach.

Human factors questionnaire. A copy of the human factors questionnaire (Cargo Truck Ranking Form) is provided in Appendix A. The questionnaire was completed by 23 drivers who had gained experience with three vehicles: the 5-ton truck (M813), the OGER truck (M520), and the Lockheed Twister Dragon Wagon (DW). However, the findings seem to apply also to the 5-ton tractor (M818), the GOER Flatbed prototype, and the Dragon Wagon in the tractor configuration, because the driver compartments and the power units in these vehicles are the same or very similar to those of the M813, M520, and DW.

All of the 23 drivers were 5-ton and GOER operators. Seventeen of the drivers were brought to the field for a period of 4 hours each to examine and drive the three types of vehicles. The other 6 drivers were specially cross-trained on the Dragon Wagon for purposes of field testing (see DRIVER TRAINING IMPLICATIONS section, below).

Noise-level instrumentation. Noise levels were measured for the Dragon Wagon, the 5-ton (M813), the GOER (M520), and the M656 cargo truck, using a sound-level meter placed in the driver compartment of each of the tested vehicles. The windows of the vehicles were open, and cargo compartments were empty. The vehicles were operated at varying speeds, engine RPM, and in various gears on a gravel road. Readings on the sound-level meter were not corrected for ambient noise because the tests were conducted in a relatively quiet environment.

The sound-level meter provided two measures of sound level in decibels. The first measure indicated unweighted decibels. The second measure indicated decibels weighted to attenuate lower frequencies, thereby approximating more closely the loudness sensitivity of the human ear. The normal human ear is sensitive to frequencies ranging between 20 to 20,000 Hz; it is most sensitive to frequencies between 500 and 6,000 Hz. To correct the sound-level meter readings for this factor, the A-weighted network, which is most widely used for simple comparisons of similar noise sources, was applied (Harris, 1957; Peterson & Gross, 1967).

#### DRIVER TRAINING IMPLICATIONS

Cross-training on Dragon Wagon. Six drivers of the 5-ton and GOER trucks were cross-trained on the Dragon Wagon. They were first given an orientation concerning controls, shifting, instruments, and vehicle characteristics including capabilities, limitations, and safety precautions for the vehicle. An experienced driver provided by the Dragon Wagon manufacturer conducted the orientation and other training.

Drivers then practiced negotiating various types of terrain. First, the experienced driver drove the vehicle over the terrain, showing the trainee how to shift, accelerate, brake, etc., and then the trainee drove with the experienced driver coaching from the passenger seat.

During subsequent practice, emphasis was placed on learning to "read the terrain." I.e., the experienced driver pointed out examples of obstacles, vegetation, and other terrain features which could be negotiated by the vehicle. He also showed the trainees terrain features which would be too difficult to attempt. This segment of training also demonstrated how to take advantage of "targets of opportunity," such as steep hills, high steps, and complex curves, for driving practice.

Backing-up operations were also included as a topic of training.

For each of the three initially selected drivers, the training period lasted approximately 2 days. For the last three drivers, the training was condensed to 1 day and less practice on "targets of opportunity" was allowed. Less than 1 day of training per driver was permitted on the tractor-trailer rigs because those vehicles used the same driver compartment and power plant as the trucks. To familiarize themselves with the tractor-trailers, drivers drove an empty vehicle around the course once, slowly, and then practiced backing up.

Training implications questionnaire. A copy of the training implications questionnaire (Evaluation of Driver Training with High Mobility Trucks) is provided in Appendix B. This questionnaire was completed by the six drivers who had been cross-trained on the Dragon Wagon.

After the drivers had completed their training period and had begun driving test runs, they answered the questionnaire on training implications. The questionnaire first asked them to evaluate and comment on the Dragon Wagon training they had received. Then it asked them to indicate driving skills that are necessary for the Dragon Wagon or GOER but not the 5-ton, and skills that are necessary for the 5-ton but not the Dragon Wagon or GOER.

#### RESULTS

##### HUMAN FACTORS

Questionnaire. The human factors questionnaire required each driver to rank the three vehicles on 36 different human factors items. The average (mean) ranks given to the vehicles on each task are shown in the first three columns of Table 1.

The responses given to each item were analyzed by using the Friedman analysis of variance with ranks (Siegel, 1956) to determine if the drivers as a group tended to rank one vehicle over another on that task. The null hypothesis, tested at the .05 level, was that the mean ranks given to the vehicles were equal. For each item where the null hypothesis was rejected, multiple comparisons of all pairs of vehicles were performed--again, using the .05 level--to determine specifically which vehicles were preferred over which other vehicles. The results of those analyses are presented as a set of "derived ranks" for each human factors item.

The derived ranks are given in the last three columns of Table 1. They represent the rank order of the observed means in the first three columns, taking into account the statistical significance of the differences among the observed means. For example, for item 1 the three mean ranks were all significantly different from one another. Therefore, the most preferred vehicle (the 5-ton, with mean rank of 1.2) was ranked "1," the

Table 1

MEAN OBSERVED RANKS AND STATISTICALLY DERIVED RANKS  
FOR HUMAN FACTORS ITEMS

Human Factors Item <sup>a</sup>	Mean Observed Rank			Derived Rank		
	DW	5-ton	GOER	DW	5-ton	GOER
Driver Compartment						
• Ease of entering/-leaving (23)	2.0	1.2	2.8	2	1	3
• Freedom from sharp corners, knobs, levers (23)	1.5	1.9	2.5	1.5	1.5	3
• Support and comfort of seats (23)	1.4	2.5	2.1	1	2.5	2.5
• Head room (23)	1.6	2.3	2.1	1	2.5	2.5
• Leg room (23)	2.1	2.0	1.9	2	2	2
• Hip/shoulder room (23)	1.7	2.1	2.2	2	2	2
• Driving position (23)	1.6	2.3	2.1	1	2.5	2.5
Visibility						
• To front (23)	1.5	2.4	2.1	1	2.5	2.5
• To sides (23)	1.8	2.1	2.1	2	2	2
• To rear (22)	1.7	2.4	1.9	1.5	3	1.5
• Freedom from glare (22)	1.4	2.2	2.4	1	2.5	2.5
Readability of Instruments						
• Speed (22)	1.4	2.2	2.4	1	2.5	2.5
• Temperature (22)	1.6	2.1	2.3	1	2.5	2.5

Table 1 (cont)

Human Factors Item <sup>a</sup>	Mean Observed Rank			Derived Rank		
	DW	5-ton	GOER	DW	5-ton	GOER
• Oil pressure (22)	1.7	2.2	2.1	2	2	2
• Air pressure (21)	1.7	2.1	2.2	2	2	2
Controls						
• Position/size of brake pedal (21)	1.5	2.4	2.1	1	2.5	2.5
• Position/size of clutch pedal (data unavailable)	-	-	-	-	-	-
• Position/size of steering wheel (22)	1.7	2.0	2.3	2	2	2
• Location of gear shift lever (21)	1.8	2.1	2.1	2	2	2
• Location of all-wheel-drive lever (22)	1.7	2.5	1.8	1.5	3	1.5
• Ease of engaging/disengaging all wheel drive (22)	2.0	2.3	1.7	1.5	3	1.5
Steering, braking, shifting						
• Ease of steering on road (19)	1.8	1.7	2.5	1.5	1.5	3
• Ease of steering across country (19)	1.6	2.0	2.4	1	2.5	2.5
• Ease of controlling in reverse (17)	1.8	1.9	2.3	2	2	2
• Ease of turning wheel when stopped or at very slow speed (19)	1.9	1.9	2.2	2	2	2

Table 1 (cont)

Human Factors Item <sup>a</sup>	Mean Observed Rank			Derived Rank		
	DW	5-ton	GOER	DW	5-ton	GOER
• Ability to feel road (19)	2.1	1.6	2.3	2.5	1	2.5
• Freedom from steering wheel vibration (19)	1.6	2.3	2.1	1	2.5	2.5
• Directional stability when braking (19)	1.5	2.3	2.2	1	2.5	2.5
• Brake pedal effort (19)	1.7	2.5	1.8	1.5	3	1.5
• Ability to stop quick (18)	1.8	2.4	1.8	1.5	3	1.5
• Ease of shifting (18)	1.7	2.5	1.8	1.5	3	1.5
• Adequacy of transmission/- gear ratios (responsiveness, smoothness of shifts, amount of shifting required) (18)	1.5	2.2	2.3	1	2.5	2.5
Ride						
• Smoothness on road (22)	1.4	2.0	2.6	1	2	3
• Smoothness across country --smooth terrain (21)	1.3	2.1	2.6	1	2	3
• Smoothness across country --rough terrain (22)	1.3	2.1	2.6	1	2	3
Sustained operation						
• Preferred vehicle for sustained operations (4 hours or more) (21)	1.4	1.9	2.7	1	2	3

Note. Smaller numerical values indicate more preferred; larger, less preferred.

<sup>a</sup> Numbers in parentheses indicate number of drivers who ranked all vehicles on the item.

least preferred (the GOER, with mean rank of 2.8) was ranked "3," and the Dragon Wagon, which fell between the others, was ranked "2." Where the mean ranks between two vehicles were not significantly different, they were assigned the same derived rank. For example, in item 2, the mean ranks for the Dragon Wagon and the 5-ton were both significantly greater than the mean rank for the GOER, but not significantly different from each other. Consequently, the GOER was ranked "3," and ranks "1" and "2" were split between the Dragon Wagon and the GOER by assigning them each a derived rank of 1.5. Where no significant differences occurred among the three mean ranks for an item, the derived rank is "2" for all three vehicles (obtained by splitting "1," "2," and "3" evenly among the three vehicles).

The group of drivers ranked the Dragon Wagon as number one, over both the other vehicles, on 16 of 35 items. The M813 5-ton was ranked number one, over the other two vehicles, on two items: "ease of entering and leaving cab" and "ability to feel road." The Dragon Wagon and the M813 were both ranked number one, over the GOER, on two items: "freedom from sharp corners, knobs, and levers in cab" and "ease of steering on road." On six items the Dragon Wagon and the GOER were both ranked number one, over the M813. On nine items the drivers felt there were no significant differences among any of the vehicles.

Noise levels. The two sets of noise-level measures (unweighted and weighted decibels) are shown in Table 2. In all cases when the gear, speed, and RPM were similar, the noise level in the Dragon Wagon was lower than in the other three vehicles. The M813, the GOER, and the M656 were more similar in noise level, with the M813 having slightly higher noise levels at the lower speeds and a lower noise level at the highest speeds. Although these differences in noise do not appear great in absolute terms, decibels are measured on a logarithmic scale, and a 10 dB increase on the scale represents a tenfold increase in intensity of the sound stimulus. To give the reader a better understanding of the noise levels experienced in these vehicles, Figure 1 shows selected reference noise sources.

#### DRIVER TRAINING IMPLICATIONS

The findings from the training implications questionnaire are summarized below.

Driver evaluation of provided training. Four or more of the six drivers who were cross-trained on the Dragon Wagon felt that the moderate amount of training received was sufficient in the following areas: hill climbing, crossing vertical obstacles, cross-country driving, crossing ditches, backing up, transmission characteristics, use of driver controls, reading driver instruments, and safety precautions.

Table 2

## NOISE LEVELS IN DRIVERS' COMPARTMENTS OF TEST VEHICLES

Gear	Speed (MPH)	RPM	Decibels	Decibels (A-weighted)
Lockheed Twister Dragon Wagon				
<b>Low Range</b>				
1	5	1500	98	88
1	5	2000	105	93
1	5	3000	108	97
2	5	2500	108	94
2	5	3000	110	96
3-4	15	3000	111	96
3-6	15	3000	111	97
<b>High Range</b>				
1	8	3000	109	96
3-6	40	3000	112	98
5-ton Truck (M813)				
1	5	2000	109	100
2	11	2000	111	100
5	47	2000	114	101
GOER Truck (M520)				
1	4	1500	109	95
1	8	2000	109	98
1	10	2300	112	100
2	10	1500	111	96
2	16	2000	110	98
2	19	2500	113	100
5	17	1500	111	98
6	29	2000	110	105
6	33	2500	116	105

Table 2 (Cont'd)

Gear	Speed (MPH)	RPM	Decibels	Decibels (A-weighted)
Cargo 5-ton Truck (M656)				
<b>Low Range</b>				
1-2	7	1500	108	95
1-2	10	2000	112	101
1-2	13	2500	111	94
1-2	15	2800	112	105
<b>High Range</b>				
3-4	14	1500	112	98
3-4	18	2000	116	102
3-4	24	2600	113	106
3-6	50	2800	115	106

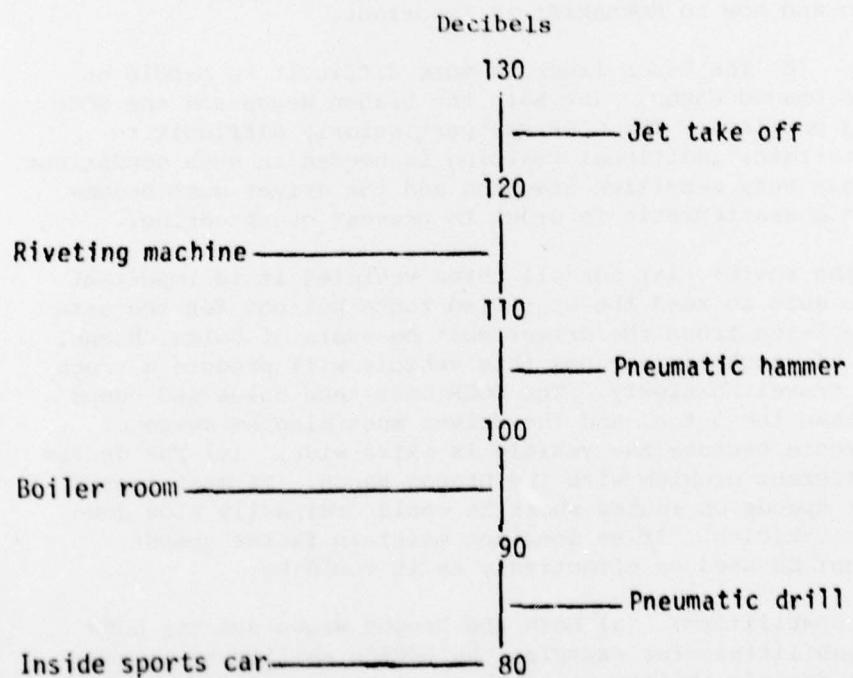


Figure 1. Examples of sounds on A-weighted decibel scale. Extracted from McCormick (1970) and Tremaine (1969).

At least three of the six drivers indicated that additional training would have been helpful in: crossing water (fording), high-speed travel, crossing thickly wooded areas, vehicle limitations, and operator maintenance.

None of the six drivers indicated that they had received too much or unnecessary training in any of the areas.

Comparison of necessary driving skills. Drivers who had driven the three vehicles were asked to indicate driver skills and knowledge that were necessary for the Dragon Wagon or GOER but not the 5-ton truck and vice versa. Their comments are synthesized under four headings:

1. Transmission and shifting: (a) With the 5-ton truck the driver must know when and how to use the clutch and gears to operate the vehicle efficiently over complex and changing terrain and to prevent engine RPM from falling too low. Especially important is the knowledge of when to downshift and the ability to do so smoothly. Also, knowing when and how to use the transfer to change from one range of gear levels to the other is important. (b) The Dragon Wagon has an automatic transmission, and the GOER a semiautomatic transmission; thus use of the clutch is eliminated, and use of the gearshift is reduced. Drivers, however, must be well familiarized with the automatic transmissions and how the gear setting and the transfer should be used in different types of terrain in order to operate the vehicle effectively. To prevent stalling in the GOER, knowing when and how to downshift is important.

2. Steering: (a) The 5-ton truck is more difficult to handle on wet roads than the Dragon Wagon. (b) Both the Dragon Wagon and the GOER have some steering problems. The GOER was particularly difficult to steer over rough terrain; additional training is needed in such conditions. The Dragon Wagon has very sensitive steering and the driver must become accustomed to that characteristic in order to prevent oversteering.

3. Reading the route: (a) For all three vehicles it is important that the driver be able to read the specified route but not for the same reasons. With the 5-ton truck the driver must be aware of holes, bumps, and other sources of roughness because this vehicle will produce a rough ride unless it is traveling slowly. The GOER must take holes and bumps even more slowly than the 5-ton, and the driver must also be aware of the width of the route because the vehicle is extra wide. (b) The driver has a slightly different problem with the Dragon Wagon. He must learn to maintain faster speeds on routes where he would ordinarily slow down with the other two vehicles. If he does not maintain faster speeds, the vehicle will not be used as effectively as it could be.

4. Vehicle capabilities: (a) Both the Dragon Wagon and the GOER have important capabilities--for example, the GOER's ability to cross mud and the Dragon Wagon's ability to climb steep hills and smooth the ride across rough terrain. Familiarization with all the capabilities of

each of the vehicles is desirable during training. Likewise, the limitations of each vehicle should be thoroughly covered during training. (b) It takes several weeks of driving time to become thoroughly familiar with the Dragon Wagon. The initial tendency is to treat the Dragon Wagon like any other cargo vehicle of similar size; consequently, its capabilities are not fully used until time and experience build up the driver's confidence to the point where he will use the vehicle appropriately.

#### CONCLUSIONS

Results from the human factors questionnaire indicate that when compared, the Dragon Wagon is clearly superior to the 5-ton M813 and the GOER M528. Out of 26 items on which there were statistically significant differences, the Dragon Wagon was ranked above the other two vehicles on 16 items and tied for first place on 8 of the remaining 10 items. In contrast, the 5-ton and GOER were approximately equal. The 5-ton was ranked higher than the GOER on 8 of the 26 items; the GOER was ranked higher than the 5-ton 6 times. They were tied on 12 of the 26 items.

In terms of noise levels, the Dragon Wagon was again superior to the other vehicles tested--5-ton M813, GOER M520, and M656 cargo truck. Differences in perceived loudness resulting from the differences in decibel levels are larger than might be inferred from an initial examination of the data. As a point of reference, Tremaine (1969) reported that a decrease in noise level from 100 dB to 95 dB produced a 35 percent decrease in loudness, and a decrease from 100 dB to 90 dB produced a 56 percent decrease in loudness. Thus, it can be reasoned that the differences in noise level between the Dragon Wagon and the other three vehicles will be noticeable to drivers and passengers.

According to the unweighted decibel readings, all of the vehicles' noise levels are below the threshold of pain, but several border on the threshold of discomfort. The threshold of discomfort is the minimum value of sound pressure of a given frequency that will cause discomfort to a listener 50 percent of the time (Tremaine, 1969). A similar definition applies to the threshold of pain. At the frequencies involved here, the discomfort threshold begins at about 118 dB, and pain begins at about 140 dB. Because the actual noise levels in these vehicles will vary around the recorded readings, it can be expected that at times the noise levels in the GOER, the M656, and perhaps even the M813 will cross the discomfort threshold when these vehicles are operated at higher speeds.

One important question regarding noise levels is whether extended exposure is likely to produce permanent hearing loss. This question cannot be answered on the basis of the limited data collected in this test, but a warning can be raised. According to Peterson and Gross (1967), "An A-weighted sound level about 90 dB indicated that the noise may be unsafe for everyday exposure, at least for some people, and further measurements are then necessary to determine if noise reduction or ear

protection is necessary" to prevent permanent hearing loss. As shown in Table 2, nearly all the A-weighted readings were over 90 dB. Further investigation of the noise levels experienced in these vehicles is therefore desirable, particularly for the M813 because it is already widely used by Army drivers who do not wear ear protection. Ear protection is currently required for drivers and passengers of the GOER.

Finally, only one vehicle of each type was tested for noise level. Whether the particular vehicles are typical of all vehicles within each type is unknown. Consequently, these results should not be viewed as conclusive, but should be cross-validated with additional vehicles.

Because only six drivers were involved in driver training, the findings regarding training implications may not be conclusive. However, the six drivers were experienced drivers, having driven trucks and tractor-trailers for lengths of time ranging from 9 months to 8 years.

With respect to training, the following implications should be considered in any driver training program for the Dragon Wagon or GOER:

- (a) All 14 topics listed earlier in the section headed "Driver evaluation of provided training" should be included in a training program. In particular, the topics that deal with capabilities and/or limitations of the vehicles should be stressed.
- (b) In training drivers on the Dragon Wagon or GOER, a course that gradually increased difficulty of terrain could be set up to give trainees a variety of experiences with the vehicles. Various types of terrain and obstacles should be incorporated to take the vehicles close to the limits of their capabilities. Starting with the easy terrain, a driver could work up to the most difficult terrain, thereby building the knowledge and confidence necessary to operate the vehicle appropriately.
- (c) The Dragon Wagon has an automatic transmission and the GOER has a semiautomatic transmission which makes the task of learning how and when to shift gears less complex. However, this aspect of driving should still be emphasized, because considerable shifting of gears is required in order to use the vehicles most efficiently over changing terrain.
- (d) Because of the more sensitive steering of the Dragon Wagon and the GOER, drivers should be allowed to familiarize themselves with the steering at slow speeds and on level terrain before attempting more difficult routes. The GOER may also require additional practice over rough terrain because of the difficulty of steering in such conditions.

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## Appendix A

### HUMAN FACTORS QUESTIONNAIRE

Form 5a was used to elicit drivers' judgments concerning human factors characteristics of the vehicles. Half the drivers received the form as shown here while the other half received a form with the order of vehicles reversed. While the M656 truck is shown on this form, that column was not used because the truck had not yet arrived for testing when the rankings were recorded.

FORM 5a

SAMPLE

## CARGO TRUCK RANKING FORM

NAME \_\_\_\_\_ GRADE \_\_\_\_\_ SSAN \_\_\_\_\_

MOS \_\_\_\_\_ POSITION IN UNIT ASSIGNED \_\_\_\_\_

DRIVING EXPERIENCE 5-TON TRUCK AND UP: VEHICLE MONTHS DRIVEN

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

INSTRUCTIONS: You are participating in a field test to evaluate high mobility cargo vehicles. As part of that evaluation your opinions about the vehicles are needed. Please rank the vehicles below on each of the characteristics listed. Give a rank of a 1 to the vehicle you think is best, a rank of 2 to the second best vehicle and continue assigning ranks until you have put a number on the line for each vehicle you have driven. If you have not driven one of the vehicles, put an X through its name at the top of the page.

VEHICLES

<u>VEHICLE CHARACTERISTIC</u>	Dragon Wagon Truck	5-ton Truck	GOER Truck	M656 Truck
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DRIVER COMPARTMENT:

1. Ease of entering and leaving cab. \_\_\_\_\_
2. Freedom from sharp corners, knobs, levers in the cab. \_\_\_\_\_
3. Support and comfort of seats. \_\_\_\_\_
4. Head room in the cab. \_\_\_\_\_
5. Leg room in the cab. \_\_\_\_\_
6. Hip and shoulder room in the cab. \_\_\_\_\_
7. Driving position. \_\_\_\_\_

## FORM 5a (cont)

VEHICLE CHARACTERISTIC	<u>VEHICLES</u>			
	Dragon Wagon Truck	5-ton Truck	GOER Truck	M656 Truck
<u>VISIBILITY:</u>				
8. Visibility to front.	—	—	—	—
9. Freedom from glare.	—	—	—	—
10. Visibility to rear.	—	—	—	—
11. Visibility to sides.	—	—	—	—
<u>INSTRUMENTS:</u>				
12. Readability of instruments:				
a. Speed	—	—	—	—
b. Temperature	—	—	—	—
c. Oil pressure	—	—	—	—
d. Air pressure	—	—	—	—
<u>CONTROLS:</u>				
13. Position and size of brake pedal.	—	—	—	—
14. Position and size of clutch pedal.	—	—	—	—
15. Position and size of steering wheel.	—	—	—	—
16. Location of gear shift level.	—	—	—	—
17. Location of all wheel drive lever.	—	—	—	—
18. Ease of engaging and disengaging all wheel drive.	—	—	—	—

## FORM 5a (cont)

VEHICLE CHARACTERISTIC	VEHICLES			
	Dragon Wagon Truck	5-ton Truck	GOER Truck	M656 Truck
<u>STEERING, BRAKING &amp; SHIFTING:</u>				
19. Ease of steering on the road.	—	—	—	—
20. Ease of steering across country.	—	—	—	—
21. Ease of controlling in reverse.	—	—	—	—
22. Ease of turning wheel when stopped or at very slow speed.	—	—	—	—
23. Ability to feel the road.	—	—	—	—
24. Freedom from steering wheel vibration.	—	—	—	—
25. Directional stability when braking.	—	—	—	—
26. Brake pedal effort required.	—	—	—	—
27. Ability to make quick stops.	—	—	—	—
28. Ease of shifting gears.	—	—	—	—
29. Adequacy of transmission/gear ratios (responsiveness, smoothness of shifts, amount of shifting required).	—	—	—	—
<u>RIDE:</u>				
30. Smoothness of ride on road.	—	—	—	—
31. Smoothness of ride across country.	—	—	—	—
a. Smooth terrain	—	—	—	—
b. Rough terrain	—	—	—	—
<u>OVERALL:</u>				
32. Preferred vehicle for sustained operations (4 hrs or more).	—	—	—	—

## Appendix B

### TRAINING IMPLICATIONS QUESTIONNAIRE

Form 6a was used to elicit drivers' judgments about driver training implications regarding the vehicles. Question 2 was not used because cross-training on the GOER did not occur.

EVALUATION OF DRIVER TRAINING  
WITH HIGH MOBILITY TRUCKS

(Structured Interview)

INSTRUCTIONS: Please answer the following questions about the training you have received on the high mobility trucks.

1. In what areas of driver training with the Dragon Wagon Truck should you have had a different amount of instruction and practice before the test began? Check the appropriate block for each topic of training listed.

<u>TOPIC OF TRAINING</u>	Needed Much More Training	Needed A Little More Training	Amount if Training About Right	Needed Less Training
Hill climbing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Crossing vertical obstacles	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Crossing water (fording)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Crossing ditches	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Backing up	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
High speed travel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Transmission characteristics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Driver controls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Driver instruments	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vehicle limitations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Operator maintenance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Safety precautions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other. (Specify)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## FORM 6a (cont)

2. In what areas of driver training with the GOER Truck should you have had a different amount of instruction and practice before the test began? Check the appropriate block for each area of training listed.

<u>TOPIC OF TRAINING</u>	Needed Much More Training	Needed A Little More Training	Amount of Training About Right	Needed Less Training
Hill climbing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Crossing vertical obstacles	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Crossing water (fording)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Crossing ditches	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Backing up	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
High speed travel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Transmission characteristics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Driver controls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Driver instruments	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vehicle limitations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Operator maintenance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Safety precautions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other. (Specify)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. What driving skills are necessary for driving the Dragon Wagon Truck that are not necessary for the 5-ton truck?

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FORM 6a (cont)

4. What driving skills are necessary for driving the 5-ton truck that are not necessary for driving the Dragon Wagon truck?

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5. What driving skills are necessary for driving the GOER Truck that are not necessary for driving the 5-ton truck?

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6. What driving skills are necessary for driving the 5-ton truck that are not necessary for driving the GOER Truck?

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